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Miracle Chamber

Forage crops have traditionally been the orphans of the American agricultural scene. Farmers and ranchers do not lavish the same care on them that they do on cash crops. This benign neglect will change, however, if the world's burgeoning population forces people to compete with livestock for grain.

Many bleak forecasts of a gastronomic future with meatless meals have appeared in the popular press, but only a few have adequately assessed the role of forages in livestock production. It is a role that was ancient when some early farmer thought of feeding grain to his flock. For ruminants such as cattle and sheep are superbly endowed to thrive on forages—pasture and harvested herbage—converting fibrous materials that people cannot eat into protein-rich meat and milk. The dark of a cow's rumen harbors immense Lilliputian armies of microbes that digest and mobilize nutrients for the cow to assimilate. Some microbes digest cellulose, others make vitamins like the B-complex, while still others make digestible proteins for the cow, either from non-protein nitrogen present in forages or from that fed as urea.

The ruminant's "fermentation vat" not only digests forages, but also wastes from the processing of food for human consumption. These include byproducts from preparing flour, starch, glucose, sugar beets, and distillery products as well as rendered wastes from the meat packing industry.

An even larger source of feed for ruminants, one still to be exploited, lies in the mountain of high-fiber wastes produced each year, particularly straw. If this byproduct of grain production could be rendered digestible, by 1980 it could maintain 49 million cows—triple the present U.S. dairy herd.

Although ruminants are primarily consumers of forages, even limited protein supplementation improves their performance in feedlots and dairy parlors. So rationed, they produce more protein than they are fed. With advances in research, future protein needs of ruminants may be met through feeding nonprotein nitrogen sources such as urea, especially with low quality forages.

Agricultural science is helping us get more out of our great forage resource. But we need more public awareness, a stir of forage-consciousness throughout the world. For whatever enhances the fruitful meeting of ruminants and forages also bolsters our supply of protein foodstuffs.

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COVER: Grape cluster drops gracefully from the vine in the virus-free foundation vineyard at Davis, Calif. Since vines are grown for wood production, only a few fruit buds are left on each vine for fruiting. See page 3 (871K1018–8).

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Rx for virus-free grapes

PROLIFIC METHODS of grapevine propagation in California have permitted the production of over 68,000 certified virus-free plants from 45 mother vines of 11 varieties.

Certified virus-free plants have great dollar significance to both the $300-million-a-year grape industry and the consumer, since losses to virus diseases run up to $100 million per year.

In 1956, plant pathologists Austin C. Goheen, ARS, and William B. Hewitt of the California Agricultural Experiment Station, Davis, began establishing a foundation vineyard of disease-free, high-quality grape varieties. The vineyard—both table and wine grapes.

The foundation vineyard is to serve as a central repository of stock for the propagation of clean vines for this country and the world. Thus, only virus-free vines with good viticultural characteristics and trueness to variety can qualify.

When the scientists found no disease-free parent stock in their selections of several important varieties, they turned to virus therapy as a way of ridding the plants of viral infections. Many methods were tried, but only one proved successful.

The treatment consists basically of

Technician Carl Luhn inspects indexes of vines which are being tested to ensure that they are virus-free (871K1020–23).

heating infected plants in a growth chamber up to 100° F. and holding that temperature for 100 days. New growth that develops at the shoot tips during treatment often is virus-free.

These tips are cut off and grown under mist-propagation until they become established plants. Then they are tested for viruses—a process that takes many months—and, if virus-free, are finally planted in the vineyard.

Dr. Goheen estimates that about 300 valuable varieties are now virus-free and growing in the vineyard repository. From these vines, daughter plants are propagated and released to nurserymen for further increase and sale to growers. Thus, all should be well.

However, an unprecedented vineyard expansion is underway—extending from California with its 40,000 new acres up into Oregon and Washington. This growth, along with upgrading the varieties growing in established vineyards, has created an overwhelming demand on the limited supply of available planting stocks.

To alleviate this acute situation, Dr. Goheen and plant pathologist George Nyland of the California Station, searched for a more rapid method of increasing the foundation stock. The researchers chose the greenhouse method—until now, used only for experimental plantings.

The greenhouse technique employs heated sandbeds to root small dormant cuttings and mist propagation to root small green cuttings. Since new plants require intensive care in the greenhouse and vineyard for the first year, they are more costly than those produced by the conventional method. However, greenhouse propagation has the advantage of producing great numbers of daughter plants from a limited supply of mother wood in a short time. A single mother plant, theoretically, can produce enough offspring within one year to plant 10,000 acres of vines.

If the vines are to be planted in vineyards contaminated with soil pests, they must be grafted onto virus-free, disease-resistant rootstocks.

Despite these rapid propagating techniques, which have alleviated the acute shortage of clean stock, over 50 percent of the vines being planted in commercial vineyards today are not certified virus-free.

Dr. Goheen warns against planting uncertified vines because infected stock starts to deteriorate in 3 or 4 years and will need to be replaced. Disease-free vines reach a production peak in about 6 years and may continue a high rate of production for an indefinite period—sometimes over a century. □

To render a grapevine virus free, plants are placed in growth chamber and heated to 100° F. for 100 days. After this treatment, a tip is removed, mist-propagated, and subsequently tested for virus infection (871K1017–30).

Mr. Luhn routinely surveys foundation vineyard, looking for possible insect infestations and diseases (871K1019–11).

Female scale insects on lemons inside the cylinder attract the males, which are then caught on sticky card at top. Each trap monitors 1 to 5 acres (PN–1995).

Male approaches female scale concealed underneath shell-like covering on lemon (PN–1996).

Key to less pesticide use—— CITRUS SCALE TRAP

CITRUS GROWERS can control California red scale with less insecticide by conducting spraying operations only when a simple ARS-developed trap for the insects indicates the need.

The female scale, a legless insect under a shell-like coat, sucks the sap of citrus trees. It infests citrus-producing areas throughout the United States and the world. Severe infestations of the immobile females and immature forms can defoliate and kill untreated trees in 1 year. Males usually take flight, mate, and die within 24 hours.

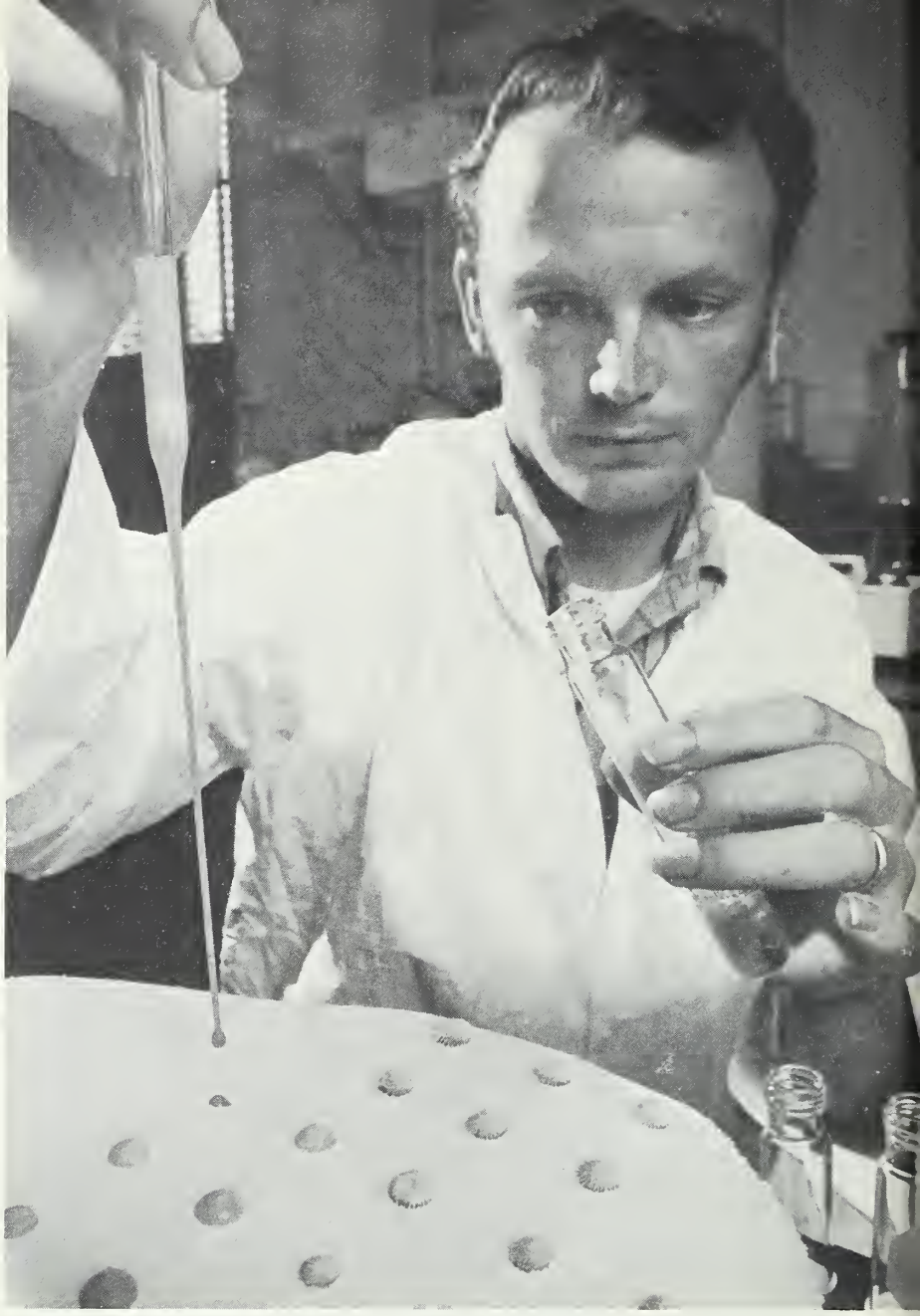
In California alone, the scale causes an estimated $5 million loss annually in damage from loss of trees and diminished yields. For control, orchards there are customarily sprayed once or twice a year—cost about $45 per acre.

Presently, inspectors visually search orchards for scale infestations, covering about 5 acres a day at a cost of $20. The new trap, however, can survey the same area more accurately and at one-tenth the cost. Moreover, it detects infestations not readily apparent to an inspector. Visually discovered infestations may be 3 years old by the time they are found. Entomologists J. Gilbert Shaw and Daniel S. Moreno and technician Joann Fargerlund, all of ARS, developed the trap system at Riverside, Calif.

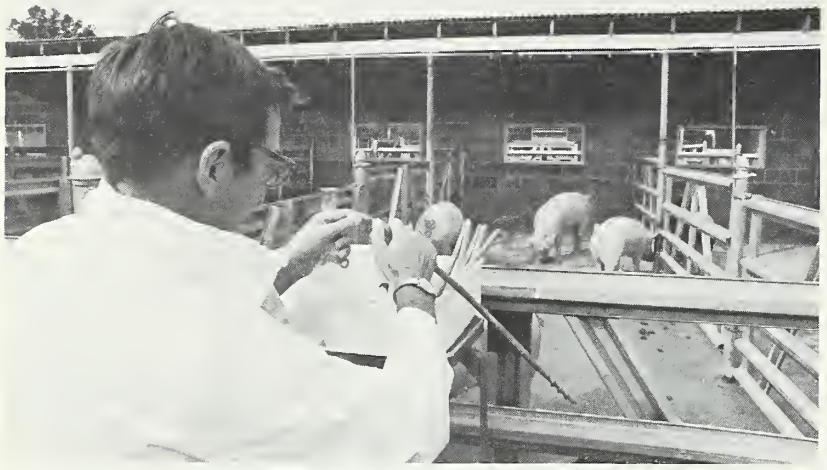
The trap consists of a 3- by 7-inch white card with a sticky coating to trap males; the card is attached to a pint ice cream carton with openings covered with very fine nylon screening (7 mesh/mm). In the carton is a lemon infested with 200 to 300 unmated females to attract males in the orchard.

In preliminary tests, Mr. Shaw and Mr. Moreno placed traps in two sprayed orchards at Indio, Calif., and found that live males still responded to the traps, indicating incomplete scale control by spraying. The traps also detected scale in two trees of an orchard that for 10 years had been thought to be free of the scale.

Other tests demonstrated that the ARS scale trap can capture 4,000 to 7,000 male scales per day in areas where the pest is well established. These results have stimulated California growers in the Coachella Valley to initiate a scale-rearing project of their own, for use in baiting traps over several thousand acres. Growers in other districts of California and Arizona are also planning to adopt the traps in their operations. □

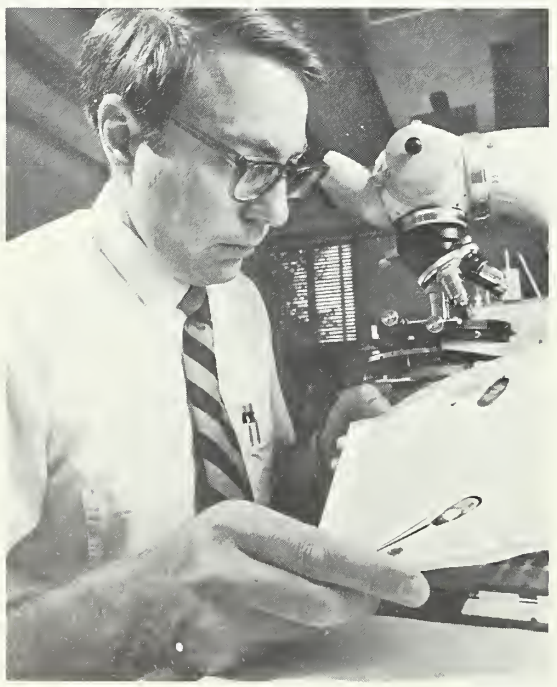


Right: *Technician William White freezes semen mixed with various types of extender into pellets (1070A936–32).*



Above: *After storage at −196°C., semen specimens are thawed and given the ultimate test—artificial insemination (1070A936–16).*

Success with FROZEN BOAR SEMEN



Checking for acrosome damage, Dr. Pursel examines photomicrographs of semen smears (1070A936–19).

A METHOD for successfully freezing boar semen brings the swine industry one step closer to artificial insemination (AI).

Frozen semen has been widely used in the cattle industry for 20 years, but freezing boar semen has met with many failures. Although some sperm motility survived freezing, the main problem has been damage to the sperm's acrosome or head cap. The acrosome contains enzymes that the sperm uses to enter and fertilize the egg. Apparently, acrosome damage prevents this vital process.

Another problem is that billions of sperm are needed per insemination to obtain fertilization in sows. The uterus of a sow destroys sperm in great quantities so that few are available for fertilizing the eggs. The mechanism of this destruction has not been discovered.

With all these problems, however, ARS physiologists Vernon A. Pursel and Lawrence A. Johnson have developed a procedure for freezing semen that increases acrosome survival and sperm viability of thawed semen so that fertilization is possible. Workers at the University of Minnesota, St. Paul, and at Cambridge University in England have also recently reported progress in preservation of boar semen using somewhat different procedures.

In tests at Beltsville, Md., the use of frozen semen has resulted in the birth of 72 piglets from 9 sows. Other sows, inseminated and then slaughtered, were carrying embryos. In all, AI led to successful fertilization in 45 of 83 gilts.

Though AI has been successful with

the new freezing procedure, some gilts checked for pregnancy have been only partially fertile. That is, there were fewer embryos than in a natural-service pregnancy. Dr. Pursel thinks this can be remedied with refined procedures.

For AI, fresh semen is collected and diluted with an extender developed at Beltsville. The extender prevents the destruction of sperm cells during freezing. A key factor for success appears to be the addition of glycerol to the extender during cooling and its subsequent removal before the semen is actually frozen. Glycerol removal is essential for both sperm motility and acrosome integrity. With cattle semen, leaving glycerol in the extender has no harmful effects.

Cooled semen is poured into small indentations in a block of dry ice and frozen into pellets. These pellets are then collected and frozen at −196°C. The semen is thawed just before use. Thawed semen had 5 to 20 percent motility and 28 to 54 percent normal acrosomes.

Sows are inseminated with a long rubber tube that has a corkscrew-shaped end. One man can conduct the inseminating if a boar is kept in the pen next to the gilts. When a boar is present, a gilt in heat will remain still and can easily be inseminated.

AI could eliminate many of the problems of natural service, including the spreading of disease by the boar, the labor needed for hand or pen mating, and the injury to young gilts from older boars that are too heavy.

Problems that must be solved for AI to be commercially practical include detection of heat, determination of the fertility of thawed semen from a particular boar, and use of only one insemination per sow for economy.

While much research and refinement are yet necessary, the scientists are hopeful that their procedure will open the door to breeding genetically superior sires with large numbers of sows. Superior sires could be used to produce pigs with more lean meat. □

Hybrid squash seed ——economically

A GROWTH REGULATOR is making hybrid squash seed production economically feasible.

The advantages of hybrid squash seed production have been known for nearly 50 years, but massive production has been hindered by hand labor requirements. To obtain hybrid squash seed, male flowers must be eliminated from the female parent to permit cross-pollination with the selected male parent. Without an effective growth regulator, breeders have had to remove male flowers by hand—a laborious and expensive method practical only on bush-type plants. In 1969 less than 25 percent of the U.S. commercial squash crop came from hybrid seed.

Effectiveness of the growth regulator 2-chloroethylphosphonic acid (ethephon) was established by plant geneticists Richard W. Robinson of the New York State Agricultural Experiment Station, Geneva, and Thomas W. Whitaker and G. Weston Bohn of ARS, La Jolla, Calif.

They evaluated ethephon on squash plants after it had proved effective on cucumbers in retarding development of male flowers on female parent lines until the fruit starts to form.

The scientists selected plants from four cultivated species of squash representing 10 different varieties. The plants were sprayed with 250 parts per million of ethephon after the first true leaves emerged.

In each case, the first 10 nodes on the main stems of the sprayed plants produced only female flowers. Male flowers did not appear until after cross-pollination was complete and the fruit started to form.

Under production conditions, a seedsman usually plants three or four rows of the squash selection he wants to use as the female parent adjacent to one or two rows of the squash that will supply pollen. As seedlings, the female parent plants are treated with ethephon. When the flowers emerge on the parent rows, open pollination completes the hybridization process.

The scientists say that the resulting hybrids exhibit the same hybrid vigor found in plants produced by the tedious hand removal method. Ethephon is registered for use on squash. □

REARING INSECT ALLIES

THE USE of outdoor insectaries and an alternate host for parasite rearing has, for the first time, made possible the launching of a full-scale biological attack against the cereal leaf beetle.

This beetle, a European pest that invaded the United States in the late 1950's, is a serious threat to the production of wheat and other small grains. The most promising technique for biological control is the importation, rearing, and release of insects that parasitize the pest in its native lands. Three species of tiny wasp parasites were successfully released from 1967 to 1970 by plant protection scientists at the USDA Cereal Leaf Beetle Parasite Rearing Station, Niles, Mich.

To rear the massive numbers of these parasites needed for release, the host must also be reared in large numbers. This is extremely difficult with the cereal leaf beetle because in the laboratory, the beetle's reproductive rate is low, its mortality is high, and it requires a resting period between generations, making continuous production impossible.

The host problem was attacked in two ways. Entomologist Harry L. Maltby and his team of scientists at the Niles laboratory concentrated on finding an alternate host for *Anaphes flavipes*, which attacks cereal leaf beetle eggs. At the same time, scientists at Michigan State University's Kellogg Gull Lake Experimental Farm received an ARS grant to develop a new method of rearing the other two, *Tetrastichus julis* and *Diaparsius carinifer*, which attack the larvae.

After testing numerous species, Mr. Maltby discovered that the three-lined potato beetle, *Lema trilineata*, was a much more satisfactory laboratory host than the cereal leaf beetle itself. The three-lined potato beetle is available locally in large numbers and is easy to rear. It produces eight times more eggs and has a much better survival rate than the cereal leaf beetle.

This potato beetle also prefers jimson weed which is much easier to grow in the laboratory than the small grain plants required by the cereal leaf beetle.

By 1971, the Niles Station was producing twice as many *Anaphes flavipes* with potato beetle hosts as were previously reared with an equal number of cereal leaf beetle hosts. At the same time, per unit production costs were reduced by 85 percent.

Meanwhile, the Michigan State scientists working with the other two parasites, had found them completely unsuitable for laboratory rearing. Instead, the scientists developed outdoor insectaries, or rearing beds.

The insectaries are established in heavily infested grain fields located in wildlife areas or on farms retired from production where pesticide drift will not be a hazard. Each summer, parasitized cereal leaf beetle larvae are collected from the insectaries and taken to infested areas where the beneficial insects have not yet taken hold.

The parasites do not spread very far, although 1 to 3 million may be present per acre in a thriving colony. Maintaining this parasite population involves careful crop management to enable the parasites and hosts to overwinter.

During 1971, USDA and cooperating States released over 800,000 egg parasites at 109 locations in Illinois, Indiana, Kentucky, Michigan, New York, Ohio, Pennsylvania, and West Virginia. Nearly 100,000 larval parasites were freed at 11 sites in Indiana, Michigan, Ohio, and West Virginia.

USDA scientists do not think that the cereal leaf beetle can be eliminated, at least, not with current pest control weapons. Instead, a way must be found for farmers to live with the pest. That is why tremendous emphasis is being put on the parasite rearing and release program. □

Left: *Technician Janice Blevins divides and packages adult* A. flavipes *into male-female ratios designed to produce the most eggs (871K1041–9).*

Top: *After harvest, a researcher flails fields with device that knocks adult beetles out of the stubble and into a collecting basket. These beetles are used to produce eggs (871K1052–13).*
Middle left: *Mrs. Edna Arend checks egg-laying tray. Eggs are attached to the blades of oat plants as they are laid and must be washed off (871K1043–5).*
Middle right: A. flavipes *wasps parasitize cereal leaf beetle eggs (BN–38635). Inset: Egg containing three parasites (PN–1997).*
Left: *Agriculturist Gary Moorehead screens soil in the field for parasitized pupae of the cereal leaf beetle. This type of survey helps check effectiveness of the program (871K1051–3).*

The rubber fingers of the pickup harvester rake apples into the drum, then a conveyor which drops them into a bin (BN–38660).

Pickup harvester for apples

MILLIONS of pounds of apples that end up as waste each year may now be salvaged by a mechanical pickup harvester.

An average of 10 percent of the apple crop drops to the ground and may go unharvested. Michigan growers lost about 62 million pounds—$930,000 worth—by that route each year in 1968 and 1969. Juice plants where apple shortages sometimes occur also suffered. The loss equals about one-third of the total amount of apples processed annually as apple juice in the State.

Moreover, unpredictable winds sometimes cause the entire crop to drop from trees in a particular area or orchard and, without available labor, the crop may be lost.

Although some of the dropped fruit is picked, the need for a pickup harvester has been increasing in recent years as the shortage of competent labor becomes more acute. When labor is available, it is used to harvest the prime-quality fruit.

ARS agricultural engineers Bernard R. Tennes and Jordan H. Levin, East Lansing, Mich., and biochemist Robert T. Whittenberger, Philadelphia, Pa., developed and tested three methods of picking apples before settling on a rubber-finger-pickup harvester.

The machine employs hollow 6-inch-long rubber fingers, each 7/8 inch in diameter, attached to a drum in rows 2¾ inches apart. The drum, mounted on a tractor-towed, two-wheel trailer, rotates at 1½ times ground speed in the direction of travel by means of a power-takeoff hydraulic pump. The rubber fingers sweep the apples off the ground onto a retaining cloth which directs them to a rubber-coated conveyor chain, across a trash and spur elimina-

tor, and into a pallet box mounted on the unit.

The trailer has a swinging hitch controlled by the tractor operator from a console behind him. Thus, the operator works from the tractor in an open orchard row while the pickup assembly moves in beneath the trees. Any tractor in the 20- to 30-horsepower range can operate the unit.

Performance of the unit in Michigan tests was far superior to that of the other units developed by the ARS researchers—one picked up the apples by spikes on a drum while the other picked them up by wedging them between rubber disks on the drum.

Efficiency of the unit is high, capacity is large, durability is good, bruise damage is low, and operating conditions are not critical. During the tests, before the researchers recommended the unit be commercially produced, the machine picked about 1,000 bushels of apples of five varieties in seven orchards with a minimum of bruise damage. The apples were processed into juice at two large commercial plants.

Cost and maintenance of the machine is such that at a price of $1.50 per hundred pounds, a grower will have to harvest 3,000 bushels of dropped apples per year to make a reasonable profit—20 to 40 cents per hundred pounds. At 2,500 bushels, he will probably break even.

About 800 Michigan growers have 50 or more acres of apple orchards. Each grower probably loses 3,000 to 4,000 bushels of dropped apples per year. Thus, the researchers—working in cooperation with the Michigan Agricultural Experiment Station—estimate a potential need for several hundred pickup harvesters exists in Michigan alone. Small growers having less than 3,000 bushels of dropped apples per year could own a machine jointly or participate in custom harvesting.

Other rubber-finger-pickup harvesters have been manufactured for apples. Some are now being tested in Florida citrus groves. □

Conserving ground moisture with GRASS BARRIERS

A PERENNIAL GRASS barrier system which permits more intensive cropping than crop-fallow has been developed for dryland farming in the semiarid Northern Great Plains.

Up to now, farmers in this region have had to rely on less efficient crop-fallow strategies in their battle against ground moisture shortages and soil erosion. The new system promises far more flexibility in productive operations than was previously feasible—even with stubble-mulch tillage, strip cropping, and other procedures.

An exploratory experiment by ARS soil scientists Alfred L. Black and Francis H. Siddoway in Sidney, Mont., was established on a 3-acre site of Williams loam glacial till soil. Double barriers of tall wheatgrass were seeded in 36-inch rows at 30- and 60-foot intervals. These barriers, 250 feet long, were planted as nearly as possible at right angles to the prevailing northwest winter winds, and were cultivated annually by a tractor-mounted corn cultivator.

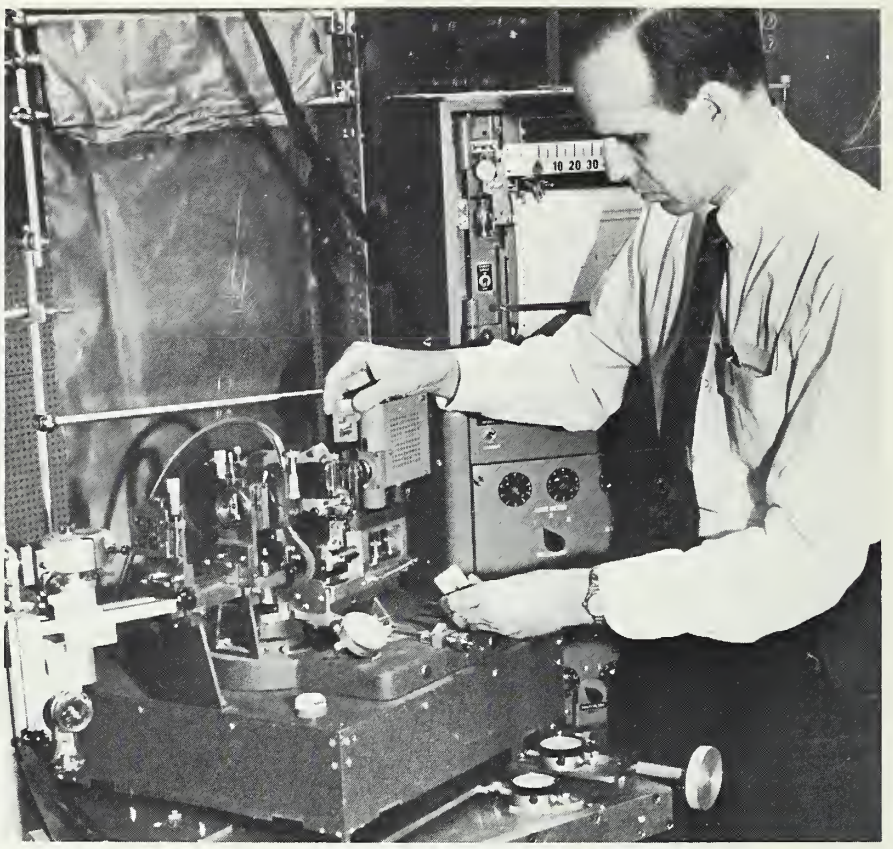
Snow deposits, water storage, and wind speeds were measured and compared with those in continuous-crop and crop-fallow check plots outside the double-barrier system.

In the continuous-crop zones between 30-foot barrier intervals, the overwinter gain and storage efficiency of soil water was almost twice that of crop-fallow, nonbarrier plots. During a 21-month span the 30- and 60-foot continuous-crop barrier sequences had 164 percent and 149 percent of the soil water storage efficiency of crop-fallow without barriers.

The double rows of wheatgrass also provided a strong line of defense against erosive winds and abrasive windblown soil that may destroy crops in their seedling stage. Again the 30-foot spacings proved most effective, with windspeeds in them reduced to a leeward 17 percent and a windward 70 percent of open field velocities as measured 1 foot above ground level.

Concurrently, the barrier system is under study on a field-size basis to determine: (1) the feasibility and nutrient requirements of more intensive cropping rotations, (2) the erosion hazard—if any—from snowmelt runoff, and (3) the effects of the barrier system on the microclimate.

Mr. Black and Dr. Siddoway have found the perennial two-barrier arrangement to be exceptional in its winter durability and snow-trapping capability. The 30- and 60-foot interval comparisons indicate that a spacing of about 50 feet between barriers might combine the most desirable snow distribution pattern with effective wind protection and still be compatible with farming operations. □



Dr. Pessen adjusts the instrument—one of the few in which the weak intensity of scattered rays can be routinely measured on the same scale as the million-fold higher intensity of the incident beam (PN–1999).

Unique analytical tool

TAKING THE MEASURE OF A MOLECULE

ONE OF THE FEW INSTRUMENTS in the world capable of absolute-scale measurement of small-angle X-ray scattering is providing valuable information about proteins.

Designed and built at the ARS Eastern marketing and nutrition research laboratory in Philadelphia, Pa., this instrument exploits the fact that X-rays, like light rays, are partly scattered when they fall on a particle. Since the wavelength of X-rays is so short, most scattered X-rays go off at angles only a fraction of a degree away from the incident beam, and practically none are observable beyond about 8 degrees. Hence, the term small-angle X-ray scattering.

It is this small angular region that the instrument must be able to explore. From the way the scattered intensities are distributed as a function of angle, scientists can determine size, shape, and other information regarding the three-dimensional structure of large molecules, as well as their interactions with each other and their environment. Measuring X-ray scattering in absolute energy units requires intricate instrumentation and exacting technique, but reveals structural details not approachable by simpler X-ray measurements or by light scattering.

Physical biochemists Helmut Pessen and Thomas F. Kumosinski, together with biochemist Harold M. Farrell, Jr., all at the Philadelphia laboratory, have applied this powerful and versatile tool to the study of changes in molecular size and shape that take place when certain nutrients are bound to carrier proteins. The carriers protect the nutrient—a vitamin or mineral—from harmful interactions until it arrives at the proper physiological spot to be released and to perform its normal metabolic functions.

In one such carrier protein—the one that binds Vitamin B_2 in hen's egg—the instrument detected subtle molecular changes as the protein bound, and then released, the vitamin. These changes, confirmed by spectral measurements, have led to an explanation of the mechanism of binding which suggests important applications in nutrition. Further study of systems of this kind is expected to shed much-needed light on the way other nutrients can be stabilized in food processing and storage, as well as in the body. □

Light scattering was the basis of a widely used photometer perfected about 20 years ago by the late Dr. Brooks A. Brice, chemist at the Philadelphia laboratory. In the early 1960's chemist Serge N. Timasheff, who had also been using light scattering at the Philadelphia laboratory, became interested in X-ray scattering and its advantages and initiated construction of an X-ray apparatus. Dr. Pessen eventually took charge of this project and developed the instrument. He was assisted by Mr. Kumosinski, who also worked out computer methods to help translate the measurements into meaningful information about a sample's molecular properties.

BOK CHOY

Reducing market losses

CAREFUL SHIPPING and handling of fresh, high-quality Bok choy will help reduce bacterial soft rot and black spotting.

These two diseases are the primary causes of transit and market losses to Bok choy, also called Chinese chard or "white cabbage." Precooling quickly to remove field heat, maintaining low temperatures during transit and marketing, and moving the produce rapidly into market channels will also reduce these diseases.

Bok choy resembles both Swiss chard and celery; its broad, thick, white leaf stalk is important in the preparation of certain Chinese dishes and is a staple in some ethnic diets. Wholesalers, concerned over heavy shipment losses caused by soft rot and spotting, requested information from ARS on the nature and control of these diseases.

ARS plant pathologist Clyde L. Burton, Chicago, Ill., inspected freshly received, conventionally packed, 60-pound crates of California-grown Bok choy in a recent 2-year study. He found that most of the damage was caused by soft rot occurring at injury sites on the plant and by superficial black spot seen mainly on the fleshy petiole and midrib. When severe enough, both conditions render the plant unsightly and unmarketable.

To identify the causal agents of these diseases, Dr. Burton planted several hundred bits of tissue infected with soft rot or black spot on potato dextrose yeast-extract agar.

The isolation tests showed that two pathogens, *Pseudomonas marginalis* and *Erwinia carotovora,* were present in the soft rotted tissues. Both pathogens require wounding of host tissue before infection begins. Decay progresses rapidly once infection has begun, becoming visible within 12 hours.

In the isolation tests for black spot, no micro-organism was consistently recovered, nor were any micro-organisms seen in microscopic examination. Examination of fresh shipments for black spot showed that 25 to 50 percent of the clusters had infected petioles, an indication that the disease originates in the field, although it has not been reported there.

Samples of clusters with petioles showing early symptoms of black spot and clusters with no symptoms were stored for 3 weeks, half at 32° F. and half at 38° F. At the end of this period, clusters infested before storage showed more severe spotting, while clusters free of disease remained so.

Also, fewer spots developed on diseased Bok choy stored at 32° F. than at 38° F., indicating that some control is possible. Additional information is needed before a recommendation can be made. □

Longer storage life for radishes

CERTAIN low-oxygen atmospheres retard radish deterioration, but improper control of oxygen concentration or temperature can lead to injuries that exposure to air intensifies.

Radishes are increasingly being stored in low-oxygen atmospheres for longer storage life to accommodate prepackaging and long distance shipping. Because information on radish response to this practice has been scarce, ARS plant physiologist Werner J. Lipton, Fresno, Calif., evaluated the market quality of topped red radishes stored under various atmospheric conditions.

He held radishes in atmospheres of nitrogen and 21, 5, 2, 1, ½, or ¼ percent oxygen for 4, 8, or 15 days at 2.5°, 5°, or 10° C. Topped radishes were stored inside large glass jars along with wet paper towels to maintain high relative humidity.

Results favor a 1-percent oxygen storage atmosphere. Although low-oxygen atmospheres slow deterioration, benefits are strongly dependent on temperature and duration of storage. Radishes stored at 2.5° C., slightly above the optimal oxygen level, readily keep in air for 15 days, plus 3 days at 10° C., without any problems attributed to storage.

Even when stored at temperatures of 5° and 10° C., defects such as renewed growth of roots or tops and loss of firmness were retarded at 1 percent oxygen, while storage atmospheres below ½ percent oxygen often resulted in injury at 5° C. or above. Since temperature can't always be controlled during marketing, a 1-percent oxygen atmosphere affords a margin of safety, besides providing maximum storage life. □

"Only scholarly examination of the alternatives permits intelligent decisions. . . ." (1071X1360–28).

Atwater lecture

MAYER CALLS FOR SOCIAL ENGINEERING

SOPHISTICATED, detailed planning is the only logical approach to solving today's technological and health problems contends international nutrition authority Jean Mayer.

Presenting the 1971 Atwater Memorial Lecture entitled, "Decision Making in the Biological Field," Dr. Mayer examined three related areas—regulatory agencies, health and medicine, and environmental protection and conservation.

With the growing variety of drugs, food additives, and agricultural chemicals available, he said, regulation has tended to come in the form of reaction to a new chemical, process, or threat to the environment. Such a piecemeal approach often creates as many problems as it solves.

Dr. Mayer recommended that interdisciplinary study groups examine systematically, but critically, recent and proposed regulatory agency decisions.

Nowhere, he went on, is the need for systematic planning more evident than in the fields of health and preventive medicine. He cited the rocketing costs of medical care while life expectancy in the United States has dropped from 11th place in the world in 1949 to close to 40th. Cardiovascular disease is mainly responsible, Dr. Mayer said. "We have . . . returned to the days of the great pandemics, when a fourth or half of the population died of one disease. This time, the pandemic is a degenerative rather than an epidemic disease."

Dr. Mayer maintained that the cause of this present disaster is not only biological, but sociological. Untreated hypertension, lack of exercise, obesity, hypercholesterolemia, insufficient sleep—sociological artifacts of our way of life—all seem to be involved in this degeneration.

Through poor social engineering, he said, "we are in the process of abolishing all physical exercise." We inherited a body capable of roaming vast stretches of wilderness in pursuit of game. Now, in the course of the past 50 years, our physical activity has suddenly dropped to nearly zero. Dr. Mayer proposed that we build physical exercise into our lives—by planning communities, for example, that encourage walking.

"Similarly, we must turn our food supply around, using our technological capabilities to produce meats and convenience foods lower in saturated fat, lower in salt, and, in many cases, lower in sugar." Dr. Mayer also called for a new ethic to provide guidance for treatment of animals and conservation of nature. Our traditional Western thinking has never provided such guidance, he said.

Dr. Mayer concluded his lecture with the plea that biological man be considered in any decisions involving our food supply, fuel policy, transportation system, our housing and urban planning, and recreational programs.

The Atwater Memorial Lecture is sponsored by ARS to honor USDA's first chief of human nutrition research, Dr. Wilbur O. Atwater. The 1971 Lecture was presented before the Second National Biological Congress, under the auspices of the American Institute of Biological Sciences. The Congress met in Miami Beach, Fla. □

Date pollination made easier

After years of research, the problem of mechanizing date palm pollination now appears to be near solution.

Two devices, the bloom duster and the palm duster, were tested on Deglet Noor date palms by agricultural engineers Eudell G. Vis and Galen K. Brown, both of ARS, and Roger M. Perkins of the California Agricultural Experiment Station, Riverside. They conducted their experiments on 17 acres of dates over a 3-year period.

The bloom duster is a compressed air device operated by a man in a basket on a harvesting tower. He directs a puff of dry pollen toward each bloom and is moved from palm to palm. This two-man system can pollinate about 1 to 1⅓ acres per hour.

The palm duster, mounted on a trailer, has a blower that forces air through a pipe to the blooms. A mixture of pollen and flour is metered into the airstream and spread over the blooms. The duster operator stands on a platform attached to a fork-lift mast which can be adjusted vertically. The system also uses two men and can pollinate about 2½ acres per hour.

Comparing either method to hand pollination showed little difference in yields or costs. With the new methods, the same acreage can be done with less manpower.

The need for mechanical pollination methods in the date industry has been great since 1964 when the bracero program was terminated. So this development, although not perfected as yet, could be of great benefit to date growers and other growers with similar problems.

Worker applies pollen to date palms with bloom duster. He stands in the basket of a machine normally used for harvesting (PN–2000).

Ventilation failure can kill birds

Under summer conditions, severe stress leading to death can occur to broiler chickens in a tight, well-insulated poultry house within an hour after loss of mechanical ventilation.

In an ARS study at State College, Miss., agricultural engineer Floyd N. Reece and poultry husbandman James W. Deaton found that increasing temperature along with high relative humidity may be responsible for the stress.

As the temperature in the house approaches chicken body temperature, evaporation of moisture from the chicken's respiratory tract is the principal method of heat rejection. At 100 percent relative humidity, heat rejection by this process is almost nonexistent, and the broilers are in trouble.

Because trouble with mechanical ventilation could be caused by a number of things besides power failure, any alarm system should be keyed to the rotation of the fan blades. A simple temporary procedure to alleviate the situation would be to open the house to expel some of the excess humidity.

Under moderate winter conditions, 4 hours or more may elapse before severe stress conditions occur. In both the winter and summer tests, ammonia and carbon dioxide levels did not appear to present a great hazard.

Mr. Reece and Dr. Deaton, working with 8-week-old broiler chickens stocked about the same as commercial flocks, made the study in cooperation with the Mississippi Agricultural Experiment Station.

Cotton that bollworms boycott

Cotton plant varieties with smooth, or glabrous, leaves carry few bollworm and tobacco budworm eggs.

Entomologists are not sure whether female moths of the *Heliothis* genus fail to lay a full complement of eggs on the glabrous varieties or whether the wind dislodges more eggs from the glabrous leaves than from bristly leaves.

Regardless of the reason, from 36 to 80 percent fewer eggs were found on glabrous cotton strains than on bristly

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strains during a 5-year study. ARS entomologists Maurice J. Lukefahr and Harry M. Graham and technician James E. Houghtaling, Brownsville, Tex., similarly found reductions in larval populations ranging from 41 percent in 1967 to 67 percent in 1969. The Texas Agricultural Experiment Station, College Station, cooperated in some of these studies.

Although the glabrous character cannot be expected to impart total resistance to bollworms and tobacco budworms, the suppression it provides may result in more manageable numbers. An integrated control method combining limited use of insecticides with a glabrous cotton variety could reduce the larval population to below the damaging level.

Many times during the cotton-growing season, *Heliothis* populations are marginally damaging to currently grown strains. When insecticides are used at these times, beneficial insects are also destroyed. Thus the need for continued treatment may result. Glabrous cotton varieties might permit other biological controls to be used more effectively.

Bean products pass consumer tests

Consumers are enthusiastic about two new bean products.

Both products, pinto bean powder and quick-cooking frozen beans, were developed by scientists at the ARS Western regional research laboratory, Berkeley, Calif., and have been commercially prepared under the supervision of ARS engineers.

Pinto bean powder was tested in a California chain of Mexican food smorgasbord restaurants. In one restaurant, it was used to make refried beans, a favorite Mexican dish. Customers leaving the restaurant told interviewers that they liked the taste and texture of the new product.

The powder was also used in commercially prepared frozen Mexican-style pizzas. As a result of trials, the manufacturer placed an initial order for 20,000 pounds.

The quick-frozen beans require only 8 to 12 minutes to cook without presoaking. They have a natural flavor, texture, and appearance.

In initial sales tests conducted in the Southeast, consumer and grocer reactions were enthusiastic, and repeat sales were good. Two commercial firms are now planning further test marketing of the beans.

These products are the result of continuing ARS research to develop new foods, high in nutrition and low in cost, for the American public.

Improving seed germination

Electricity may prove to be a key that unlocks seeds with tough, water-proof coatings which prevent germination.

In a coordinated effort, scientists have found that cottonseed with impermeable seedcoats can be easily germinated when exposed to an electric glow-discharge. Germination also improved when three varieties of alfalfa seed were exposed to radiofrequency (RF) dielectric heating, microwave heating, and hot air. Once the seedcoats became permeable, increased germination resulted.

In the cottonseed experiments, ARS scientists in Maryland, Nebraska, and Tennessee tested seed lots of selection 16–B–7, a generally impermeable seed cotton. Both gin-run and saw-ginned lots were treated. Germination of gin-run seed was increased from 10 percent to 60 to 90 percent by exposure to electric glow-discharge. No increase in germination of the saw-ginned cotton was noted. Significant but smaller germination increases were also provided by RF electrical treatment.

In testing alfalfa seed, scientists in Nebraska discovered that RF dielectric, microwave, and hot air heating were equally effective. At proper exposures, they reduced hard-seed content without damaging germination. Results of RF treatment of alfalfa seed were the same as those first reported in 1968 (AGR. RES., May 1968, p. 11).

Additional study is needed before recommendations for use can be made. At present, the methods are not yet economically feasible, nor is any one approach reliable for all kinds of seed.

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